TRANSPORTER FOR DELIVERING SECONDARY SUPPLY OF INSERTS TO A PACKET OF PRIMARY MULTIPLE PACKET INSERTER APPARATUS

RELATED APPLICATIONS

[0001] This application claims the priority benefit of provisional patent application no. _____ filed November 26, 2003, said provisional application being hereby incorporated by reference into the present specification.

TECHNICAL FIELD

[0002] This invention relates to the field of handling equipment for thin, flimsy sheet articles such as advertising materials, fliers and other inserts for printed newspaper sections and, more particularly, to conveying apparatus especially adapted for transporting such articles as individual sheets or short stacks thereof at high speeds and in succession from a source of supply such as an in-line collator to the inserting station of a high-speed newspaper inserting machine.

BACKGROUND AND SUMMARY

[0003] Newspaper and/or commercial inserting machines that stuff multi-page inserts into opened, generally V-shaped newspaper or similar jackets moving at high speeds are well-known in the industry. However, a particular problem is sometimes encountered when it is desired to stuff thin, flimsy single sheets or stacks of single sheets into the jackets at the desired high line speeds. Conventional hopper-type feeders available in association with conventional machines sometimes have a difficult time dispensing the individual sheets and are largely incapable of handling collated stacks of the individual sheets, especially at the required high line speeds. For capacity reasons, it would be very desirable to collate a number of different individual sheets into a short stack and then stuff the assembled stacks in succession into corresponding jackets, as this would avoid the need to add an additional dispensing hopper and inserting station at the inserting machine for each different sheet.

[0004] The present invention is directed to apparatus that replaces a hopper or other feeder at one of the loading stations of a multi-station newspaper and/or commercial inserting machine and which has particular utility in feeding articles that comprise single sheets or stacks of single sheets to the loading station at high speeds while maintaining complete control over the articles throughout their entire path of travel from a source of supply into the open newspaper or other V-shaped jacket

product moving past the loading station. Although the principles of the present invention have particular utility in connection with circular, carousel-type inserting machines such as the well known HARRIS/Heidelberg/AM Graphics brand circular machine in which a series of product holding buckets or pockets move sequentially beneath loading stations having overhead feeders, it will be appreciated that the present invention is not limited to use with the HARRIS- type machine or to a carousel-type machine for that matter. It will also be appreciated that the while the present invention is particularly suited for use in connection with an inline collating machine as the source of supply, such as the KANSA MULTI-FEEDER available from Kansa Technology LLC of Emporia, Kansas, the present invention is not limited to use of a MULTI-FEEDER as the source of supply.

[0005] In a preferred embodiment, the present invention includes a conveying apparatus and method wherein the single-sheet or multiple-sheet articles are conveyed along a path of travel from the source of supply, and in the process of such conveyance are turned or rotated a certain distance about the longitudinal axis of the path of travel so as to reposition and properly orient the articles for insertion into the moving pockets of the inserting machine. In a preferred embodiment, the articles are rotated approximately one-quarter turn to accomplish the necessary reorientation. Preferably, such rotational action is carried out by a pair of high-speed, relatively narrow and opposed conveyor belt lengths that are twisted about their respective longitudinal axes and which clamp and convey the articles along the path of travel while at the same time causing the rotating action. Special guide rods located alongside the path of travel of the articles and in close association with the twisted belt lengths engage the articles as they are being operated upon by the belts to assist in carrying out the rotating action. Other cooperating conveyor belt stretches upstream from the article-rotating portion of the apparatus may be arranged in such a manner that articles coming from the source of supply in a horizontal disposition are essentially turned on end and reoriented for edge-wise vertical delivery down into the top-loading inserting machine. The conveyor apparatus may be upwardly arched for carrying out such up-ending of the articles so that the path of travel of the articles includes and initial upwardly directed leg, a transition leg in which the path of travel changes from upwardly to downwardly, and a third downwardly moving leg immediately above the loading station.

[0006] Even though the articles may be conveyed over a fairly lengthy path of travel compared to a short path of travel available with overhead feeding hoppers, the present invention provides a way of maintaining firm control over the articles throughout the entirety of the transporting path of travel. A discharging portion of the conveyor apparatus may be provided immediately downstream from the article rotating portion thereof for taking control of the newly

reoriented articles and discharging them in rapid succession down into the receiving pockets that move successfully therepast and therebelow.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Figure 1 is a fragmentary top plan view of conveyor apparatus constructed in accordance with the principles of the present invention and illustrated in association with a circular newspaper or other product stuffing machine and an in-line collator for supplying individual sheets or stacks of individual sheets to the conveyor apparatus;

[0008] Fig. 2 is a front elevational view thereof;

[0009] Fig. 3 is a fragmentary, slightly enlarged, vertical cross sectional view thereof with shields and end panels of the apparatus removed to reveal details of construction;

[0010] Fig. 4 is an enlarged fragmentary horizontal cross sectional view through the apparatus taken substantially along line 4-4 of Fig. 2;

[0011] Fig. 5 is a fragmentary, vertical cross sectional view through the apparatus taken substantially along line 5-5 of Fig. 4;

[0012] Fig. 6 is a fragmentary, vertical cross sectional view through the apparatus taken substantially along line 6-6 of Fig. 5;

[0013] Fig. 7 is an enlarged front elevational view of the article rotating or twisting portion of the apparatus with sidewalls and housing portions removed to reveal internal details of construction;

[0014] Fig. 8 is an enlarged, fragmentary right side elevational view of the article rotating or twisting portion of the apparatus with sidewalls, panels and housing removed to reveal details of construction;

[0015] Fig. 9 is an enlarged, fragmentary rear elevational view of the article rotating or twisting portion of the apparatus with panels, sidewalls and housings removed to reveal details of construction;

[0016] Fig. 10 is an enlarged, fragmentary left side elevational view of the article rotating or twisting portion with panels, walls and housing removed to reveal details of construction;

[0017] Fig. 11 is a horizontal cross sectional view through the article rotating or twisting portion of the apparatus taken substantially along line 11-11 of Fig. 10;

[0018] Fig. 12 is a fragmentary, vertical cross sectional view through the article rotating apparatus taken substantially along line 12-12 of Fig. 11;

[0019] Fig. 13 is a fragmentary, vertical cross sectional view of the article rotating or twisting apparatus taken substantially along line 13-13 of Fig. 11;

[0020] Fig. 14 is a fragmentary, horizontal cross sectional view of the article rotating or twisting portion of the apparatus taken substantially along line 14-14 of Fig. 12;

[0021] Fig. 15 is a fragmentary horizontal cross sectional view through the article rotating or twisting apparatus showing guides for the twisting and conveying belt lengths in that region of the machine;

[0022] Fig. 16 is a fragmentary horizontal cross sectional view through the article rotating or twisting apparatus from a point above the twister belt guides of Fig. 15 and illustrating guiding mechanism at that location;

[0023] Fig. 17 is an enlarged perspective view of a set of guide rods in the article rotating or twisting portion of the apparatus that assists in carrying out the one-quarter turn rotation of the articles as they move along the path of travel, the phantom lines representing a pair of successive articles that undergo the rotating action;

[0024] Fig. 18 is a fragmentary perspective view of the twisted, article rotating belts located in the article rotating or twisting portion of the apparatus;

[0025] Fig. 19 is an enlarged perspective view of the air cylinder control assembly at the lower discharge end of the apparatus that controls the angle of discharge of the cooperating discharge conveyor assemblies at that location;

[0026] Fig. 20 is a longitudinal cross sectional view through the control cylinder of Fig. 19;

[0027] Fig. 21 is a schematic diagram illustrating a system for synchronizing motor speeds of the various parts of the entire collating, transporting, and inserting mechanism, and for controlling the angle of discharge of the conveyor assemblies at the discharge end of the apparatus as a function of the operating speed of the main newspaper and/or commercial inserting machine; and

[0028] Fig. 22 is a schematic diagram illustrating the manner in which articles are rotated one-quarter turn for insertion into the top loading inserting machine and, if necessary, are turned on edge from an initial, horizontal position at the source of supply.

DETAILED DESCRIPTION

[0029] The present invention is susceptible of embodiment in many different forms. While the drawings illustrate and the specification describes certain preferred embodiments of the invention, it is to be understood that such disclosure is by way of example only. There is no intent to limit the principles of the present invention to the particular disclosed embodiments.

[0030] Figs. 1 and 2 show transporting or conveying apparatus broadly denoted by the numeral 10 for supplying articles such as flimsy single sheets or stacks thereof to a high speed, multi-station circular newspaper and/or commercial inserting machine 12. The source of such articles may be an inline collator denoted by the numeral 14. In one preferred embodiment of the invention, the collator 14 may take the form of a KANSA MULTI-FEEDER available from Kansa Technology LLC of Emporia, Kansas. Generally speaking, the collator 14 is most advantageously operable to collate a number of flat, flexible insert sheets into a stack or package forming an article to be conveyed into inserting machine 12, although it is within the scope of the present invention for the source of supply to simply feed individual sheet materials to the conveying apparatus 10 for subsequent delivery to the newspaper and/or commercial inserting machine 12. In one preferred embodiment, the articles supplied by the collator 14 are oriented horizontally on a flat conveying surface with their planar surfaces facing upwardly and downwardly respectively. An axis normal to the plane of such articles thus extends generally vertically upwardly.

[0031] The present invention has utility in connection with a variety of different high speed newspaper and/or commercial inserting machines, both circular and inline. In the illustrated embodiment, the circular machine 12 may advantageously comprise a well-known HARRIS/Heidelberg/AM Graphics brand inserting machine having multiple top loading insert stations about its periphery as designated generally by the alphabet designations A, B, C, D, E and F in Figs. 1 and 2. Stations B-F are provided with dispensing hoppers 16, 18, 20, 22 and 24 respectively, while the transporting apparatus 10 takes the place of a dispensing hopper at station A. As illustrated in Fig. 1, the conveying apparatus 10 and collator 14 approach circular machine 12 in a radial direction.

[0032] Generally speaking, and as well understood by those skilled in the art, the inserting machine 12 has a number of buckets or pockets 26 that move sequentially in a circular path of travel beneath the dispensing hoppers 16-24 and the outlet of conveyor apparatus 10 for the purpose of receiving insert articles into opened newspaper or other product sections or jackets within the pockets 26. Each pocket 26 receives an insert article at each of the stations A-F during one complete revolution so as to build up a complete package of jacketed inserts. The complete jacketed package is discharged from each successive pocket 26 by means not illustrated. Advertising slicks, weekly news magazines, and specialty sections are but a few of the wide variety of different article types that can be inserted at the machine 12 by hoppers 16-24. Advantageously, the station A with conveyor apparatus 10 and collator 14 may be utilized to insert a stacked compilation of individual sheet items

at one station, thereby greatly increasing the capacity of the machine 12 without adding additional inserting stations and hoppers thereto.

[0033] With reference initially to Figs. 1-3, the conveyor apparatus 10 generally includes three primary portions, i.e., a transporting and turning portion 26 leading from collator 14 for traversing most of the distance between collator 14 and inserter machine 12 and for turning the articles from a horizontal condition to an on-end or edgewise orientation; an article rotating portion 28 vertically aligned with insert station A above the later for receiving the edgewise article from turning portion 26 and rotating it through a one-quarter turn for proper insertion into the radially extending pockets 26 of inserting machine 12; and an article discharging portion 30 at the lower end of rotating portion 28 for receiving the quarter-turned articles from rotating portion 28, establishing firm control over such quarter-turned articles, and driving them down into the radially oriented pockets 26 passing rapidly in succession below discharging portion 30.

[0034] This turning, rotating and discharging action is depicted generally in a simplified manner in Fig. 22 wherein it may be seen that the overall path of travel 32 of the articles from collator 14 to the inserting machine 12 is upwardly arched to present an upwardly oriented first leg 34, a gently arched intermediate or second leg 36 in which the path of travel 32 transitions from upwardly directed to downwardly directed, and a third downwardly directed leg 38 leading from second leg 36 and aligned directly above insert station A. A representative article 40 in Fig. 22 departs from collator 14 in a horizontal condition with an axis 42 that is normal to the plane of article 40. Article 40 then moves upwardly along the first leg 34 of path of travel 32 through the transporting and turning portion 26 of conveyor apparatus 10. Article 40 then moves around the apex of its path of travel through second leg 36 and turns downwardly as it nears third leg 38 comprising the article rotating portion 28. By the time it enters third leg 38 of its path of travel, article 40 is on edge with article axis 42 projecting horizontally as it needs to for insertion into pocket 26. As article 40 continues along third leg 38, it is rotated or twisted one-quarter turn about the longitudinal axis 44 of path of travel 32 so that the plane of article 40 is extending in a radial direction with respect to the axis of rotation of circular machine 12. As article 40 completes its descent along the lower region of its path of travel 32, it is maintained in its radial orientation and is inserted down into the pocket 26.

[0035] As illustrated particularly in Figs. 1, 3, 4 and 5, collator 14 has a horizontally disposed discharge conveyor 46 that supports the horizontally disposed articles as they move leftwardly out of the machine and generally toward inserter 12. As the articles exit conveyor 46, they are received by a receiving conveyor assembly 48 that includes a top set of four, relatively narrow conveyor belts

50 looped around rollers 52 on a cross shaft 54 that overlies conveyor 46 and is driven by collator 14. At their opposite end, belts 50 are looped around four corresponding rollers 56 mounted on a transversely extending common shaft 58 that is supported at its opposite ends by a pair of links 60, 62 that extend longitudinally of the path of travel and back toward collator 14. The two links 60, 62 are journaled at their upstream ends to a transverse pivot shaft 64 so that links 60, 62 can swing upwardly and downwardly to a certain extent about pivot shaft 64. Another pair of laterally spaced links 66 and 68 are pivoted on pivot shaft 64 slightly outboard of links 60, 62 and extend therefrom in an upstream direction to support a transverse shaft 70 carrying four idler rollers 72 below the top stretch of belts 50. Links 66, 68 may thus also move up and down about pivot shaft 64 to a certain extent during operation.

[0036] Receiving conveyor assembly 48 further includes four relatively narrow conveyor belts 74 (Fig. 5; only one belt 74 being illustrated) immediately below belts 50 and in vertical alignment therewith. Belts 74 are wrapped around four rollers 76 on a transverse shaft 78 that is journaled by opposite sides of the frame of conveyor apparatus 10. Shaft 78 projects outwardly beyond such frame on the backside thereof as shown in Fig. 4 for driving connection with collator 14 by a pulley 80 and a belt 82. Rollers 76 associated with belts 74 are disposed in close proximity to the discharge end of discharge conveyor 46 so as to effectively form a continuation of the lower conveying surface provided by discharge conveyor 46. At their downstream ends, belts 74 are looped around a set of four corresponding idlers 84 mounted on a shaft 86 directly below pivot shaft 64. Articles leaving collator 14 on discharge conveyor 46 thus become clamped between conveyor 46 and belts 74 on the bottom and belts 50 on the top so as to positively drive and control the articles. Rear links 66 may pivot upwardly about pivot shaft 64 as need be to permit idler rollers 72 to be forced upwardly by the moving article as may be necessary to accommodate the particular thickness of the article being conveyed.

[0037] A diverter gate broadly denoted by the numeral 88 is disposed immediately downstream from idler shaft 86 and includes a series of fingers 90 that are interspersed between belts 50 as illustrated in Fig. 4 and are normally maintained down at the level of the other surface of belt 74 as illustrated in Fig. 5. However, fingers 90 are interconnected by a transverse rod 92 and are mounted for up and down swinging movement about a transverse pivot shaft 94 at their downstream ends so that fingers 90 can be flipped up from their stowed positions of Fig. 5 into the path of travel of the moving articles for the purpose of blocking further advancement of the articles and diverting them downwardly out of the path of travel of the conveying apparatus in the event that such diversion

of the articles is temporarily needed for any reason. An air cylinder 96 (Fig. 5) is operably coupled with diverter gate 88 for operating the same between its two extreme positions.

[0038] Receiving conveyor assembly 48 additionally includes a relatively short bottom set of narrow belts 98 that are looped around corresponding downstream rollers 100 mounted on a transverse shaft 102 directly below corresponding upper rollers 56. The upstream ends of belts 98 are looped around four small rollers 104 on the pivot shaft 94 of diverter gate 98. Shaft 102 of rollers 100 projects outwardly beyond the rear of the frame of the conveyor apparatus as shown in Fig. 4 and is drivingly coupled with the drive mechanism of collator 14 by a drive belt 106 and a pulley 108 on the other end of shaft 102. As illustrated in Fig. 6, tension springs 110 apply downward bias to a crossbar 112 that structurally interconnects swingable links 60, 62 to urge top rollers 56 down into engagement with bottom rollers 100.

[0039] The transporting and turning portion 26 of conveyor apparatus 10 primarily includes two opposed pairs of long, relatively wide and continuous belts 114 and 116 that are guided by a multiplicity of transverse rollers. At the upstream end of conveyor portion 26, an upper transverse roller 118 cooperates with a lower transverse roller120 to define an entry nip for articles from the discharge end of receiving conveyor assembly 48 as illustrated in Fig. 5. The side-by-side belts 116 are wrapped around top roller 118 at that location, while belts 114 are looped around the lower roller 120. Belts 114 and 116 extend upwardly along a tall upright leg 122 of the conveyor frame defining the first upright leg 34 of the path of article travel, then along an arched portion 124 of the frame defining the second leg 36 of the path of travel 32, and thence partly down a third, downwardly extending leg 126 of the conveyor frame defining portions of the third leg 38 of the path of article travel.

[0040] Shortly after entering the downwardly projecting leg 126 of the conveyor frame, the two sets of belts 114 and 116 are looped around two pairs of opposed, transverse drive rollers 128 and 130, the belts 114 being looped around rollers 130 and the belts 116 being looped around rollers 128. Located between the upstream rollers 118, 120 and the downstream rollers 128, 130 are a multiplicity of transverse guide rollers 132 that cooperate to support the belts 114, 116 and to create a pair of opposed, inter-engaging stretches that serve to effectively clamp and drive successive articles from rolls 118, 120 on the one hand to the rolls 128, 130 on the other hand. Although rolls 118, 120 are opposed to one another at the upstream end of the belt runs and rolls 128, 130 are similarly opposed at the downstream end of the stretches, the guide rollers 32 are so disposed that none of the rollers are directly opposed to one another along the remaining length of the opposed stretches. This facilitates accommodating various thicknesses of articles without the need for making

any of the guide rollers 132 moveable toward and away from one another. Cooperating pairs of edge guide rollers 134 are strategically positioned along the slack side runs of belts 114 and 116 in disposition for engaging opposite edges of such belts to maintain proper positioning of the belts along the length of the guide rollers 132, the entry rollers 118, 120, and the exit rollers 128, 130.

[0041] Referring also now to Figs. 7-10, the belts 114, 116 are driven by a motor 136 supported at the upper end of a frame tower 138 associated with article rotating portion 28 of the conveyor apparatus. As illustrated in Fig. 9, motor 136 has an output shaft 140 on the backside of conveyor apparatus 10 that carries a pulley 142 drivingly engaged by an endless drive belt 144. Belt 144 is looped around a driven pulley 145 on a shaft 146 that carries roll 128 so as to supply driving power from motor 136 to rolls 128. Belt 144 is also looped around a number of additional pulleys 148, 150 and 152.

[0042] Pulley 148 is fixed to a shaft 154 that passes completely through the apparatus and exits on the front side thereof where a pulley 156 is fixed thereto (Figs. 8 and 10). Pulley 156 is entrained by a belt 158 looped around a lower pulley 160 which, in turn, is fixed to a shaft 162 that carries the belt drive rolls 130. In this manner, motor 136 also supplies driving power to drive rolls 130. The shaft 154 also serves as a support means for one of the guide rollers 132 which is rotatable relative to shaft 154.

[0043] The shaft 162 for rolls 130 is carried at the lower ends of a pair of depending links 164 and 166 that are swingably supported at their upper ends on the shaft 154. Thus, while rolls 128 are fixed in their positions, rolls 130 can swing toward and away from rolls 128 to vary the width of the gap or nip created between rolls 128 and 130. Arcuate clearance slots 168 (Figs. 7 and 9) in the opposite side walls of the frame of the conveyor of the apparatus provide clearance for such movement of shaft 162. In Fig. 7, rolls 128 and 130 are shown somewhat separated, although they would normally be essentially contacting one another except during those times when articles are passing therebetween. An air spring cylinder 170 yieldably biases rolls 130 toward rolls 128 through a cross bar 172 that interconnects a pair of arms 174 and 176 fixed to respective links 164 and 166 below the axis of swinging movement thereof defined by shaft 154. Spring cylinder 170 and other spring cylinders hereinafter described may take the form of cylinders available from SMC Pneumatics Incorporated of Indianapolis, Indiana. Such cylinders are advantageously provided with an SMC series 2000 fast release regulator.

[0044] The rolls 128 and 130 represent the termination of the transporting and turning portion 26 of conveyor apparatus 10 and the beginning of article rotating portion 28. In this respect, one primary component of the article rotating portion 28 is a pair of cooperating twister belts 178 and 180

that not only continue the advancement of the articles along their path of travel but also twist and rotate such articles one-quarter turn about an axis extending axially of the path of travel. The upper end of twister belt 178 is looped around a pulley 182 (Fig. 10) rotatably mounted on shaft 146 associated with rolls 128. As illustrated in Fig. 10, pulley 182 is disposed between the two rolls 128. Similarly, the upper end of twister belt 180 is looped around a pulley 184 rotatably mounted on driven shaft 162 associated with rolls 130, the pulley 184 being located between such rolls 130. Belts 178 and 180 are so disposed as to present a pair of downwardly moving, opposed lengths 178a and 180a that cooperate to engage and grip opposite faces of the article during its movement through this portion of conveyor apparatus.

[0045] As illustrated particularly in Fig. 18, each of the belts 178, 180 is twisted one-quarter turn about its longitudinal axis so that although the upper ends of belts 178, 180 are looped around fore-and-aft axes defined by shafts 146 and 162, the lower ends of twister belts 178, 180 are looped around transverse axes defined by a pair of shafts 186 and 188 respectively. Shafts 146, 162 are thus perpendicular to shafts 186, 188. The lower end of belt 178 is looped around a pulley 190 fixed to shaft 186, while the lower end of belt 180 is looped around a pulley 192 fixed to shaft 188. Pulleys 190 and 192 are drive pulleys and are provided with circumferential, centrally disposed ribs 194 that are received within longitudinal extending, complemental grooves 196 on the interior surfaces of belts 178 and 180.

[0046] Belts 178 and 180 are relatively narrow compared to the overall width of articles being conveyed, as will subsequently be seen. Moreover, it will be noted that runs 178a and 180a of belts 178, 180 engage the articles substantially centrally thereof to facilitate the rotating and twisting action imparted to the articles. Belts 178, 180 are confined adjacent their upper ends against twisting by a pair of opposed belt guide assemblies 198 and 200 as shown in Fig. 16 that engage the return or slack sides of belts 178, 180. Below guides 198, 200, belts 178 and 180 are free to twist one-quarter turn and are guided in this respect by edge guides 202 and 204 illustrated in detail in Fig. 15.

[0047] The article rotating portion 28 of conveyor apparatus 10 further includes as a primary component a set of stationary guides broadly denoted by the numeral 206 alongside the path of travel of articles as they are advanced by twister belts 178, 180. Fig. 17 illustrates stationary guides 206 isolated from other structure of the conveyor apparatus 10 and shows a preferred form of such guides 206, namely a series of elongated, stationary guide rods 208, 210, 212, 214, 216 and 218. Guide rods 208, 210 and 212 are supported at their upper ends 208a, 210a and 212a respectively by a fore-and-aft extending beam 220 that also supports the upper twister belt guides 200 for belt 178. Similarly,

on the other lateral side of the path of travel of the articles the guide rods 214, 216 and 218 are supported at their upper ends 214a, 216a and 218a by a fore-and-aft extending beam 222 that carries the upper belt guide assembly 198 for belt 180. Guide rods 208-218 form a structure that is analogous to a twisted cage for confining articles as they are acted upon twister belts 178 and 180 and for assisting in such rotating action imparted by belts 178, 180. It will be seen in this respect that lower ends 208b, 210b and 212b are supported by a lower transverse mounting bar 224 that extends at right angles to upper support beam 220. Similarly, lower rod ends 214b, 216b and 218b are supported on a lower mounting bar 226 that extends at right angles to upper support beam 222 as illustrated in Fig. 17. An article 40 moving downwardly through stationary guides 206 is encouraged to rotate one-quarter turn between the upper end of stationary guides 206 and the lower end thereof. The rods of stationary guides 206 are configured so as to present a fairly wide but tapering entrance thereto adjacent the upper end thereof and a narrower outlet therefrom adjacent the lower end thereof.

[0048] Referring now also to Figs. 11-16, the article discharging portion 30 is disposed below article rotating portion 28 and is adapted to receive articles from the twister belts 178, 180 and the stationary guide rods 206. The lower exit end of rotating portion 128 and the upper entrance end of discharge portion 30 coincide with one another at the axes of rotation of lower pulleys 190, 192 for twister belts 178 and 180. The shafts 186 and 188 for pulleys 190 and 192 respectively are carried at the upper ends of four upwardly converging support links 228, 230, 232 and 234, with the links 228 and 230 supporting the front shaft 188 and the links 232 and 234 supporting the rear shaft 186. At their lower ends, the support links 228, 230 are swingably mounted on a cross shaft 236 that spans the tower frame. Similarly, the lower ends of links 232 and 234 are swingably mounted on a cross shaft 238. Drive shafts 186, 188 and pulleys 190, 192 are thus rendered swingable toward and away from one another.

[0049] Lower ends 208b, 210b and 212b of guide rods 208, 210 and 212 are also rendered moveable toward and away from the lower ends 214b, 216b and 218b of guide rods 214, 216 and 218 by virtue of swingable links 228, 230 232 and 234. In this regard, it will be seen that mounting bar 224 for lower guide rod ends 208b, 210b and 212b is carried by a centrally disposed block 240 that is in turn carried by a longer, horizontally extending beam 242. Beam 242 is rigidly connected to links 232 and 234 by a corresponding pair of arms 244 and 246. An air spring cylinder 247 is operably coupled between the frame tower and beam 242 to yieldably bias twister belt pulley 190 toward twister belt pulley 192. Similarly, on the front side of the apparatus, the front mounting bar 226 is carried by a centrally disposed block 248 that is in turn supported by a transversely horizontally extending beam 250. Beam 250 is rigidly joined to the front links 228 and 230 by a pair

of spaced arms 252 and 254 respectively. An air spring cylinder 256 is operably coupled between the tower frame and beam 250 to yieldably bias lower front twister belt pulley 192 toward lower rear twister belt 190. Manifestly, air cylinders 247 and 256 also serve to bias the lower ends of guide rods 208-218 toward one another.

[0050] The lower discharging portion 30 of apparatus 10 includes a pair of generally vertically extending, opposed conveyor assemblies 258 and 260 that are supported by and depend from links 228-234. Rear conveyor assembly 260 includes four endless, relatively narrow belts 262, 264, 266 and 268 that are wrapped around four corresponding rollers 270, 272, 274 and 276 fixed to shaft 186. Shaft 186 at its opposite ends is rotatably supported by a pair of upright side frames 278 and 280. At their lower ends, the four belts 262-268 are wrapped around four corresponding rollers 282, 284, 286 and 288 (Fig. 9), which are in turn fixed to a lower shaft 290 journaled at its opposite ends by the lower ends of side frames 278 and 280.

[0051] Correspondingly, front conveyor assembly 258 includes four endless, relatively narrow belts 292, 294, 296 and 298 entrained at their upper ends around a corresponding set of four rollers 300, 302, 304 and 306 that are fixed to shaft 188 for rotation therewith. Shaft 188 is journaled at its opposite ends by a pair of upwardly extending side frames 308 and 310. At their lower ends, side frames 308, 310 journal a shaft 312 carrying four rollers 314, 316, 318 and 320 fixed thereto for the corresponding belts 292, 294, 296 and 298.

[0052] At their lower ends, the rear side frames 278, 280 are fixed to a transversely extending moveable member 322 (Fig. 14). Likewise, at their lower ends the side frames 308, 310 are fixed to a moveable member 324. Members 322 and 324 are operably interconnected by a double-acting air cylinder 326 (Fig. 14) that is adapted to maintain only a slight differential in air pressure on opposite sides of the internal piston thereof so that only a light compressive action is maintained by air cylinder 326 against the lower ends of conveyor assemblies 258 and 260. A suitable cylinder for cylinder 326 is also readily available from SMC Pneumatics Incorporated of Indianapolis, Indiana.

[0053] Located directly above differential air cylinder 326 as detailed in Fig. 12 is equalizing linkage 328 that maintains the upper ends conveyor assemblies 258, 260 equally spaced apart relative to the center of the path of travel of articles therebetween as the upper ends of conveyor assemblies 258 and 260 move toward and away from one another during passage of articles therebetween. Linkage 328 includes a rear link 330 pivotally connected at its upper end to a trunnion 332 on rear beam 242. Likewise, a front link 334 is pivotally connected at its upper end by a trunnion 334 to the front beam 250. At their lower ends, links 330 and 334 are swivel-connected to opposite upper and

lower ends of a generally upright rocker lever 338 attached intermediate its opposite ends to the frame of the tower by a horizontal pivot 340.

[0054] Driving power for the discharge conveyor assemblies 258 and 260, and also for twister belts 178 and 180, is provided via a long endless belt 342 on the backside of the frame tower. At its upper end belt 342 is entrained around a pulley 344 disposed beside the pulley 152 that receives driving power from motor 136. Pulleys 152 and 344 may advantageously comprise side-by-side, fixed interconnected halves of a double pulley so that when pulley 152 is rotated by belt 144, so also is pulley 344, which in turn drives belt 342. At its lower end belt 342 is looped around a pulley 346 fixed to an input shaft 348 of a right angle gearbox 350. Gearbox 350 has an output shaft 352 (Fig. 10) that carries a pulley 354.

[0055] Pulley 354 is entrained by an endless drive belt 356 that also wraps around three additional pulleys 358, 360 and 362. Pulley 358 is fixed to the outer end of driven shaft 236 for rotating the same, while pulley 360 is fixed to the outer end of driven shaft 238 for rotating that shaft. Pulley 362 is an idler. Thus, both shafts 236 and 238 are driven shafts for supplying driving power to conveyor assemblies 258, 260 and twister belts 178, 180.

[0056] Driven shaft 236 has a pulley 364 fixed thereto slightly inboard of link 230. Pulley 364 is entrained by an endless upwardly extending belt 366 that at its upper end is looped around another pulley 368 fixed to shaft 188. Shaft 188 in turn supplies driving power to upper rollers 300, 302, 304 and 306 of front conveyor assembly 258, as well as to lower twister belt pulley 192. Similarly, a pulley 370 is fixed to shaft 238 just inboard of link 234 and is entrained by a belt 372. Belt 372 at its upper end is entrained around a pulley 374 (Fig. 11) fixed to shaft 186 for, in turn, driving upper rollers 270, 272, 274 and 276 of rear conveyor assembly 260, as well as lower belt twister pulley 190.

[0057] The lower discharge end of the conveyor assemblies 258, 260 is maintained in a vertical orientation as illustrated throughout the drawings when conveyor apparatus 10 and the circular inserting machine 12 are either idle or moving fairly slowly. However, it will be appreciated that as the inserting machine 12 is speeded up to normal operating speeds, the pockets 26 move underneath and past discharge conveyor assemblies 258, 260 quite rapidly. Therefore, it has been found desirable to adjust the angle of discharge of conveyor assemblies 258, 260 in accordance with the operating speed of circular inserter 12 so that conveyor assemblies 258, 260 are angled somewhat forwardly at their lower ends with respect to the direction of circular travel of pockets 26. Thus, discharge conveyor assemblies 258, 260 somewhat lead the pockets 26 at full line speed so as to

provide additional time for the discharging articles to travel the distance between discharge assemblies 258, 260 and pockets 26.

[0058] Such adjustment of the discharge angle is accomplished in part by a discharge angle adjustment air cylinder broadly denoted by the numeral 376 illustrated in detail in Figs. 19 and 20, but also seen in several of the other figures. Angle adjustment cylinder 376 comprises a modified double-acting air cylinder that includes a barrel 378 having an internal chamber 380. Ports 382 and 384 communicate from the outside with chamber 380 at opposite ends thereof to receive air from supply lines 386 and 388 as shown in Fig. 19. A piston 390 is adapted to shift within chamber 380 toward and away from opposite ends thereof, depending upon the air pressure supplied to ports 382 and 384. Piston 390 has a stem 392 that projects outwardly from one end thereof and is mechanically coupled with the side frame 280 of rear conveyor assembly 260 by a connector 394 as seen in Figs. 11 and 13.

[0059] Secured to the end of barrel 378 opposite stem 392 is a cylindrical block 396 and a cylindrical end cap 398. An externally threaded stop rod 400 passes through the end of barrel of 378, block 396 and end cap 398 and carries a gripping knob 402 at the outer end thereof. An internally threaded sleeve 404 contained within end cap 398 threadably engages rod 400 so as to advance or retract stop rod 400 within chamber 380 when knob 402 is rotated after loosening a set screw 406. The inboard end of stop rod 400 thus serves as a limit stop for piston 390, determining the amount of retraction of stem 392 into barrel 378. Because stem 392 is mechanically connected to the sideframe of rear conveyor assembly 260, when pressurized air is admitted into port 382, rear conveyor assembly 260 is pulled angularly out of its vertical position until piston 390 comes into engagement with the inboard end of stop rod 400. Due to the pressure differential air cylinder 326 that always seeks to maintain the lower discharge ends of discharge conveyors 258, 260 in contacting engagement with one another, front conveyor 258 swings along with rear conveyor 260 into the angled position. The extent of such angled position is determined by appropriate adjustment of knob 402, followed by retightening set screw 406 to retain stop rod 400 in the selected position. On the other hand, the admittance of pressurized air into the port 384 when piston 390 is against stop rod 400 causes piston 390 to move to the opposite end of barrel 378, extending stem 392 and returning the discharge conveyors 258, 260 to their vertical positions as shown throughout the figures.

[0060] Fig. 21 is a schematic illustration of a system for controlling and synchronizing the motor speeds of the inserting machine 12, the conveyor apparatus 10, and the collator 14 with the discharge angle control cylinder 376. A motor 408 of the circular inserter 12 is mechanically coupled to an encoder 410 that produces a pulsed output signal related to the speed of motor 408. That signal

is delivered to a drive controller 412 associated with the conveyor apparatus drive motor 136 to control the speed of conveyor apparatus 10. An output from drive controller 412 is delivered to a control unit 414 which processes the signal and sends an output to a solenoid valve 416 that controls which of the ports 382, 384 of control cylinder 376 will receive pressurized air, and which will be communicated with atmosphere. Both of the lines 386, 388 leading to cylinder 376 are provided with adjustable needle valves 418 and 420 respectively for feathering the entry and exit of pressurized air to and from cylinder 376.

[0061] When the inserter motor 408 reaches a predetermined speed as sensed by encoder 410, drive controller 412 and control unit 414, solenoid 416 is actuated to admit pressurized air into cylinder 376 through line 388 so as to retract stem 392 to the extent permitted by the adjusted stop rod 400, correspondingly changing the delivery or discharge angle of the discharge conveyors 258, 260. On the other hand, when the operating speed drops below the set level, solenoid 416 is deactuated to admit pressurized air into cylinder 376 via line 386 and exhaust air via line 388, extending stem 392 and returning discharge conveyor assemblies 258, 260 to their normal vertical orientations. Control unit 414 also sends control signals to drive controllers associated with collator 14 such as, for example, the four drive controllers 422, 424, 426, and 428. Such controllers regulate the speeds of their corresponding motors 430, 432, 434 and 436, it being noted that the number of such motors and drive controllers can vary widely depending upon the nature of collator 14 and the number of loading stations associated therewith.

[0062] One type of encoder suitable for performing the function of the encoder 410 is available from Heidenhain Corporation of Schamburg, Illinois as Model ROD4861024. The control unit 414 and the various drive controllers 412, 422, 424, 426 and 428 may also be obtained from Heidenhain Corporation as a DKCO2.3 drive controller featuring a SERCOS interface and a CCD control unit with a SERCOS interface. The barrel 378 and related parts of control cylinder 376 may comprise a standard double-acting single rod series CG1 cylinder available from SMC Corporation of Indianapolis, Indiana, and fast release regulators associated with each of the air spring cylinders of the conveyor apparatus 10 may comprise SMC series 2000 regulators.

OPERATION

[0063] The operation and use of conveyor apparatus 10 should be apparent from the foregoing description. Therefore, suffice it to say at this juncture that, as illustrated in Fig. 22, as the articles 40 travel in succession from collating machine 14 along the path of travel 32, they are upended into a vertical or upright orientation along the article turning portion 26 of conveyor apparatus 10 and are twisted or rotated about an axis 44 extending longitudinally of the path of travel

32 along the article rotating portion 28 of apparatus 10. This orients the articles 40 radially to match the radial orientation of the pockets 26 so that articles 40 can be forcibly, rapidly and reliably stuffed down into pockets 26 as the latter move successively past and below the discharge portion 30 of conveyor apparatus 10.

[0064] Due to the cooperating efforts of the conveyor belts 114 and 116 of article turning portion 26, the articles are maintained under complete control at all times, notwithstanding the fact that they may comprise loose, flimsy sheets stacked one upon the other. As such articles leave conveyor belts 114 and 116 and enter the twister portion 28 of apparatus 10, the twister belts 178 and 180 assume firm, secure control over the articles and turn them one-quarter turn into their proper radial orientations. Guide rods 208-218 cooperate during this quarter-turn twisting action to maintain control over the articles and to assist in carrying out the quarter-turning motion. When the articles are then received by the cooperating discharge conveyor assemblies 258 and 260 of discharge portion 30, the articles are maintained in their radial dispositions for a short distance of travel so as to assure that complete control continues to be exerted as they are stuffed down into the pockets 26.

[0065] The inventor(s) hereby state(s) his/their intent to rely on the Doctrine of Equivalents to determine and assess the reasonably fair scope of his/their invention as pertains to any apparatus not materially departing from but outside the literal scope of the invention as set out in the following claims.